10. Recalculations and Improvements

Each year, emission and sink estimates are recalculated and revised for all years in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks,* as attempts are made to improve both the analyses themselves, through the use of better methods or data, and the overall usefulness of the report. In this effort, the United States follows the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance* (IPCC 2000), which states, "It is good practice to recalculate historic emissions when methods are changed or refined, when new source categories are included in the national inventory, or when errors in the estimates are identified and corrected."

The results of all methodology changes and historical data updates are presented in this section; detailed descriptions of each recalculation are contained within each source's description contained in this report, if applicable.

Table 10-1 summarizes the quantitative effect of these changes on U.S. greenhouse gas emissions and Table 10-2 summarizes the quantitative effect on U.S. sinks, both relative to the previously published U.S. Inventory (i.e., the 1990 through 2005 report). These tables present the magnitude of these changes in units of teragrams of carbon dioxide equivalent (Tg CO_2 Eq). In addition to the changes summarized by the tables below, the following sources and gases were added to the current inventory:

- CO_2 emissions from Cropland remaining Cropland, which include CO_2 emissions from agricultural liming and urea fertilization;
- CO_2 emissions from Petroleum Systems, which account for vented, fugitive and process upset emissions sources from 29 activities for crude oil production field operations; and
- CH_4 and N_2O emissions from Composting.

The Recalculations Discussion section of each source presents the details of each recalculation. In general, when methodological changes have been implemented, the entire time series (i.e., 1990 through 2005) has been recalculated to reflect the change, per IPCC (2000). Changes in historical data are generally the result of changes in statistical data supplied by other agencies.

The following emission sources, which are listed in descending order of absolute average annual change in emissions between 1990 and 2005, underwent some of the most important methodological and historical data changes. A brief summary of the recalculation and/or improvement undertaken is provided for each emission source.

- *Agricultural Soil Management*. Changes occurred as a result of incorporating state-level N fertilizer application data for on-farm use as opposed to regional data, revising assumptions of manure N availability for land application, and revising DAYCENT parameterization for sorghum. Overall, changes resulted in an average annual increase in N_2O emissions from Agricultural Soil Management of 67.4 Tg CO_2 Eq. (18.3 percent) for the period 1990 through 2005.
- *Net CO_2 Flux from Land Use, Land-Use Change, and Forestry*. Forest Land Remaining Forest Land is the principal section contributing to the change in net CO_2 flux from Land Use, Land-Use Change, and Forestry sector. The addition of newly available forest inventory data as well as some refinements in previously existing data were the principal factors contributing to the changes. Changes for the period 1990 through 2005, as compared to the estimates presented in the previous inventory, are based on the cumulative effects of (1) incorporating and updating state and sub-state inventory data, and (2) including a portion of Alaska forest for the first time. Minor refinements to the harvested wood product contribution included (1) shorter half-life for decay in dumps and (2) separation of decay in dumps from decay in landfills. Overall, these changes, in combination with adjustments in the other sources/sinks within the sector, resulted in an average annual increase in net flux of CO_2 to the atmosphere from the Land Use, Land-Use Change, and Forestry sector of 20.9 Tg CO_2 Eq. (2.6 percent) for the period 1990 through 2005.

- *Landfills*. For municipal solid waste landfills, changes to historical data resulted from revising the proportion of waste disposed of in managed landfills versus open dumps prior to 1980 and from using the recommended IPCC (2006) default value for uncharacterized land disposal. Additionally, Energy Information Administration, Landfill Methane Outreach Program, and flare vendor databases were updated, affecting estimates of CH_4 recovery. Overall, changes resulted in an average annual decrease in CH_4 emissions from landfills of 11.4 Tg CO_2 Eq. (7.8 percent) for the period 1990 through 2005.

- *Enteric Fermentation.* Changes in the estimates of CH_4 emissions resulting from Enteric Fermentation occurred as a result of (1) modifying the Cfi coefficient based on the revised IPCC equations (IPCC 2006), (2) updating the C factor in accordance with the revised IPCC Guidelines (IPCC 2006), (3) revising the equation for net energy of growth (NEg), (4) modifying the Cattle Enteric Fermentation Model to output at the state level and include more detailed data inputs, (5) incorporating revised FAO horse population estimates for 2001 through 2005, and (6) including revised USDA estimates of swine population for 2005. Overall, changes resulted in an average annual increase in CH_4 emissions from Enteric Fermentation of 11.4 Tg CO_2 Eq. (9.9 percent) from 1990 through 2005.

- *Substitution of Ozone Depleting Substances.* An extensive review of chemical substitution trends, market sizes, growth rates, and charge sizes, together with input from industry representatives, resulted in updated assumptions for the Vintaging Model, which is used to calculate emissions from this category. These changes resulted in an average annual decrease in hydrofluorocabon (HFC) emissions from the Substitution of Ozone Depleting Substances of 8.1 Tg CO_2 Eq. (12.6 percent) for the period 1990 through 2005.

- *Settlements Remaining Settlements.* The data source used for N fertilization was updated for N_2O Emissions from Settlement Soils. This fertilization data is based on county-scale non-farm application amounts from a USGS database. Overall, changes resulted in an average annual decrease in N_2O emissions from Settlements Remaining Settlements of 4.1 Tg CO_2 Eq. (73.9 percent) for the period 1990 through 2005.

- *Manure Management.* Several changes were made in this section. First, a major change in the N_2O emission calculations is that emissions are now calculated from the "bottom-up" such that emissions are calculated for each animal group, manure management system, and state. These values are then summed to calculate the total greenhouse gas emissions from manure management in the United States. Second, dairy heifers and beef on feed now have one WMS distribution that represents managed and unmanaged systems, and emissions are calculated for each WMS using the EF for that system, and not using a state average EF. Third, the inventory now includes indirect N_2O emissions in the manure management sector associated with N losses from volatilization of nitrogen as ammonia (NH_3), nitrogen oxides (NOx), and leaching and runoff. Fourth, the days per year used in N_2O calculations was changed from 365 to 365.25 to include leap years and to be consistent with the CH_4 inventory calculations. Fifth, changes were also made to the current calculations involving animal population data. Overall, the changes resulted in an average annual increase in N_2O emissions from Manure Management of 4.0 Tg CO_2 Eq. (43.1 percent) for the period 1990 through 2005.

- *Coal Mining.* Three changes were made across the coal mining sector. First, recalculations of emissions avoided at three JWR coal mines in Alabama were performed as the mining company reported and filed data for 1991 through 2005; data was also provided for 2006. Secondly, the gas content values assigned to each coal basin in the surface mine emissions component of the inventory were changed to reflect recent work carried out by U.S. EPA. Third, the conversion factor used to convert from mmcf of methane was updated to be consistent across the inventory. Overall, the changes resulted in an average annual increase in CH_4 emissions from Coal Mining of 3.7 Tg CO_2 Eq. (6.2 percent) for the period 1990 through 2005.

- *Ammonia Manufacture and Urea Consumption*. CO_2 emissions estimates were revised for all years to incorporate a new methodology that estimates urea production and consumption based on urea consumed as fertilizer. The new methodology allocated CO_2 emissions associated with urea applied as fertilizer to the Land Use, Land-Use Change, and Forestry chapter. Overall, the changes resulted in an average annual decrease in CO_2 emissions from Ammonia Manufacture and Urea Consumption of 3.0 Tg CO_2 Eq. (15.8 percent) for the period (1990 through 2005).

- *Wastewater Treatment.* For domestic centralized wastewater systems, CH_4 emissions were revised to be based on the total BOD_5 entering wastewater treatment plants. Additionally, a major data change included adjusting US Census Bureau American Housing Survey data. For industrial wastewater, the 2006 estimates include a change in calculation methodology for pulp and paper, and the inclusion of wastewater emissions from U.S. starch-based ethanol production. Finally, emissions associated with ethanol production were estimated and included in this sector. Overall, the changes resulted in an average annual decrease in CH_4 emissions from Wastewater Treatment of 1.6 Tg CO_2 Eq. (6.4 percent) for the period (1990 through 2005).

Table 10-1: Revisions to U.S. Greenhouse Gas Emissions (Tg CO_2 Eq.)

Gas/Source	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	**5.5**	**8.1**	**(1.7)**	**1.8**	**14.5**	**18.6**	**(8.4)**	**3.9**
Fossil Fuel Combustion	+	2.4	(7.8)	(4.3)	7.6	12.4	(12.5)	0.3
Non-Energy Use of Fuels	(0.1)	+	0.4	0.5	0.5	0.4	(1.3)	(3.3)
Natural Gas Systems	+	+	+	+	+	+	(0.1)	1.3
Cement Manufacture	NC	NC	NC	NC	NC	NC	NC	NC
Lime Manufacture	0.7	1.2	1.5	1.4	1.3	1.4	1.4	1.5
Limestone and Dolomite Use	NC	NC	NC	NC	NC	NC	NC	NC
Soda Ash Manufacture and Consumption	NC	NC	NC	NC	NC	NC	NC	NC
Carbon Dioxide Consumption	+	+	+	+	+	+	+	+
Municipal Solid Waste Combustion	NC	NC	(0.4)	(0.4)	(0.1)	(0.4)	+	(0.2)
Titanium Dioxide Production	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
Aluminum Production	NC	NC	NC	NC	NC	NC	NC	+
Iron and Steel Production	NC	NC	NC	NC	NC	NC	NC	NC
Ferroalloy Production	NC	NC	NC	NC	NC	NC	NC	NC
Ammonia Manufacture and Urea Consumption	(2.4)	(2.7)	(3.2)	(3.4)	(3.6)	(3.7)	(3.7)	(3.5)
Phosphoric Acid Production	NC	NC	NC	NC	NC	NC	NC	NC
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC	(0.1)
Silicon Carbide Production and Consumption	NC	NC	NC	NC	NC	NC	NC	NC
Lead Production	NC	NC	NC	+	+	NC	+	+
Zinc Production	NC	NC	NC	NC	NC	NC	NC	NC
Cropland Remaining Cropland[a]	7.1	7.0	7.5	7.8	8.5	8.3	7.6	7.9
Petroleum Systems[a]	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Land-Use, Land-Use Change, and Forestry (Sink)	(23.8)	54.3	83.8	17.9	(14.1)	(48.4)	(48.2)	(49.4)
International Bunker Fuels	+	+	NC	NC	NC	NC	2.7	4.9
Wood Biomass and Ethanol Consumption	+	+	(1.0)	NC	NC	(0.1)	NC	20.9
CH_4	**(0.4)**	**(0.5)**	**5.6**	**7.7**	**7.8**	**9.5**	**5.3**	**(0.3)**
Stationary Combustion	(0.6)	(0.6)	(0.7)	(0.6)	(0.6)	(0.6)	(0.6)	(0.4)
Mobile Combustion	+	+	(0.1)	0.1	(0.1)	(0.1)	(0.1)	(0.1)
Coal Mining	2.2	0.6	4.5	4.8	4.8	4.8	5.2	4.7
Abandoned Underground Coal Mines	+	+	+	+	+	+	+	+
Natural Gas Systems	0.2	(0.1)	(0.1)	(0.1)	(0.1)	(0.4)	(5.1)	(8.7)
Petroleum Systems	(0.6)	0.9	2.4	2.8	3.1	3.4	3.3	(0.2)
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC	NC
Silicon Carbide Production and Consumption	NC	NC	NC	NC	NC	NC	NC	NC
Iron and Steel Production	NC	NC	+	+	+	+	NC	NC
Ferroalloy Production	NC	NC	NC	NC	NC	NC	NC	NC
Enteric Fermentation	11.2	11.7	11.1	11.1	11.2	11.6	11.9	12.4
Manure Management	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.5

Rice Cultivation	NC	NC	NC	NC	NC	NC	NC	+
Field Burning of Agricultural Residues	+	+	+	+	+	+	+	+
Forest Land Remaining Forest Land	NC	NC	NC	NC	NC	NC	NC	NC
Landfills	(11.4)	(13.0)	(11.1)	(10.1)	(10.3)	(9.3)	(9.5)	(8.3)
Wastewater Treatment	(1.8)	(0.8)	(1.8)	(1.7)	(1.7)	(1.7)	(1.7)	(1.6)
Composting[a]	0.3	0.7	1.3	1.3	1.3	1.5	1.6	1.6
International Bunker Fuels	NC	NC	NC	NC	NC	NC	+	+
N_2O	**62.9**	**74.9**	**56.4**	**72.9**	**65.1**	**59.1**	**71.1**	**69.2**
Stationary Combustion	0.5	0.6	0.6	0.6	0.6	0.7	0.7	1.0
Mobile Combustion	(0.2)	(0.2)	(0.7)	0.2	(1.2)	(1.3)	(1.4)	(1.5)
Adipic Acid Production	0.1	0.1	0.2	0.2	0.2	0.2	0.2	(0.1)
Nitric Acid Production	(0.9)	(1.0)	(1.0)	(0.8)	(0.9)	(1.4)	(0.8)	0.1
Manure Management	3.4	3.8	4.1	4.2	4.3	4.3	4.4	4.4
Agricultural Soil Management	63.7	74.9	55.8	70.6	64.4	59.0	70.4	67.4
Field Burning of Agricultural Residues	+	+	+	+	+	+	+	+
Wastewater Treatment	(0.1)	+	+	0.2	+	(0.1)	(0.1)	+
N_2O from Product Uses	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Municipal Solid Waste Combustion	NC	NC	NC	NC	NC	NC	NC	NC
Settlements Remaining Settlements	(4.1)	(4.2)	(4.1)	(3.7)	(3.8)	(3.9)	(4.1)	(4.0)
Forest Land Remaining Forest Land	NC	NC	NC	NC	NC	NC	NC	NC
Composting[a]	0.4	0.8	1.4	1.4	1.4	1.6	1.7	1.7
International Bunker Fuels	NC	NC	NC	NC	NC	NC	+	+
HFCs, PFCs, and SF_6	**(0.4)**	**(3.4)**	**(11.1)**	**(11.8)**	**(13.2)**	**(15.2)**	**(17.3)**	**(19.5)**
Substitution of Ozone Depleting Substances	+	(3.1)	(10.9)	(12.3)	(13.9)	(15.7)	(17.9)	(21.0)
Aluminum Production	NC	NC	NC	NC	NC	NC	+	NC
HCFC-22 Production	NC	NC	NC	NC	NC	NC	NC	NC
Semiconductor Manufacture	NC	+	+	+	+	+	(0.4)	0.1
Electrical Transmission and Distribution	(0.4)	(0.4)	(0.1)	+	0.1	+	0.3	0.8
Magnesium Production and Processing	+	+	+	0.5	0.6	0.6	0.6	0.6
Net Change in Total Emissions[b]	**67.7**	**79.1**	**49.2**	**70.6**	**74.2**	**72.1**	**50.7**	**53.3**
Percent Change	**0.8%**	**2.3%**	**2.1%**	**1.4%**	**1.0%**	**0.4%**	**0.0%**	**0.1%**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)
[a] New source category relative to previous inventory.
[b] Excludes net CO_2 flux from Land Use, Land-Use Change, and Forestry, and emissions from International Bunker Fuels and Wood Biomass and Ethanol Consumption.
Note: Totals may not sum due to independent rounding.

Table 10-2: Revisions to Net Flux of CO_2 to the Atmosphere from Land Use, Land-Use Change, and Forestry (Tg CO_2 Eq.)

Component: Net CO_2 Flux From Land Use, Land-Use Change, and Forestry	1990	1995	2000	2001	2002	2003	2004	2005
Forest Land Remaining Forest Land	(23.1)	57.6	87.9	22.3	(9.2)	(43.9)	(44.1)	(44.9)
Cropland Remaining Cropland	(1.9)	(2.0)	(1.9)	(2.0)	(2.6)	(2.2)	(1.5)	(1.6)
Land Converted to Cropland	6.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Grassland Remaining Grassland	(2.0)	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Land Converted to Grassland	0.3	NC	NC	NC	NC	NC	NC	NC
Settlements Remaining Settlements	(3.1)	(3.7)	(4.3)	(4.4)	(4.5)	(4.6)	(4.7)	(4.8)
Other	NC	NC	(0.3)	(0.3)	(0.2)	+	(0.2)	(0.5)

Net Change in Total Flux	**(23.8)**		**54.3**		**83.8**	**17.9**	**(14.1)**	**(48.4)**	**(48.2)**	**(49.4)**
Percent Change	**-3.3%**		**6.6%**		**11.1%**	**2.3%**	**-1.7%**	**-6.0%**	**-5.8%**	**-6.0%**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)
Note: Numbers in parentheses indicate a decrease in estimated net flux of CO_2 to the atmosphere, or an increase in net sequestration.
Note: Totals may not sum due to independent rounding.